57. (New) The device of claim 52, wherein the device comprises a lighting device.

58. (New) The device of claim 52 wherein the adhesion promoter comprises a carbon-dissolving, carbide forming, or low melting point material.

59. (New) The device of claim 58, wherein the adhesion-promoter comprises an adhesion-promoting layer.

REMARKS

Entry of the foregoing, reexamination and reconsideration of the subject application are respectfully requested in light of the amendments above and the comments which follow.

As correctly noted in the Office Action Summary, claims 1-51 were pending. By the present response, claims 1, 4, 15, 39 and 42 have been amended. Claims 52-59 have been added. Thus, upon entry of the present response, claims 1-59 are pending and await further consideration on the merits.

Support for the foregoing amendments can be found at least at the following locations in the original disclosure: paragraphs **[0038]** and **[0044]**; and the original claims.

INFORMATION DISCLOSURE STATEMENT

As indicated on page 2 of the Official Action, U.S. Patent Application Serial Nos. 09/259,307; 09/376,457; and 09/594,844, which were listed on the PTO-1449 form submitted with the Information Disclosure Statement of July 18, 2001 have now matured into U.S. Patents. However, Applicants note that at the time the Information Disclosure Statement was prepared, these patent numbers were not yet available. Applicants have updated the specification as indicated by the above amendments to paragraphs **[0005]-[0007]**. These patents are also listed on the attached Supplementary Information Disclosure Statement.

OBJECTIONS TO THE SPECIFICATION

The disclosure stands objected to on the grounds set forth on page 2 of the Official Action. Applicants have amended paragraphs **[0023]** and **[0036]** in a manner which is believed to address these objections. Thus, reconsideration and withdrawal of the objections is respectfully requested.

DRAWING OBJECTIONS

The drawings stand objected to under 37 C.F.R. § 1.83(a) on the grounds set forth on page 2 of the Official Action. These objections are respectfully traversed.

In particular, it is alleged on page 2 of the Official Action that the drawings are deficient because they fail to show various devices recited by the claims. Namely, it is alleged that the drawings are deficient in that they fail to illustrate: an interface device box,

central office switching gear, asymmetric digital subscriber line, and high bit rate digital subscriber line. These assertions are respectfully traversed.

As stated in 35 U.S.C. § 113, "[t]he Applicant shall furnish a drawing where necessary for the understanding of the subject matter to be patented" (emphasis added).

The above-described devices are generally well-known to those of ordinary skill in the art. Thus, they form no part of the invention, *per se*. In other words, apart from the unique electrode construction embodied by the presently claimed invention, the specific construction or details of the above-listed devices do not form a part of the presently claimed invention. In this regard, the grounds for rejection for claims 34, 36, 37 and 38 allege that such devices are known to those of ordinary skill in the art. Thus, consistent with the rationale for the grounds for rejection, a drawing figure is not necessary to understand the nature of the claimed invention, and are thus not required for the above-mentioned devices under 35 U.S.C. § 113. Thus, reconsideration and withdrawal of the objection is respectfully requested.

CLAIM REJECTIONS UNDER 35 U.S.C. § 102

Claims 1-2, 5-7, 14-15, 18-20, 25-26, 39, 41-42 and 46-48 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,866,975 to Gärtner et al. (hereafter "*Gärtner et al.*") on the grounds set forth on pages 3-4 of the Official Action.

The present invention is directed to an electrode, devices incorporating an electrode, and method of forming such electrodes and devices which advantageously possess smaller

variances and mean breakdown voltage, increased breakdown reliability, smaller electron emission turn on requirements, and stable electron emissions at high current densities.

An electrode formed consistent with the principles of the present invention is embodied by amended claim 1. Amended claim 1 recites:

> *1. An electrode comprising a first electrode material, an adhesion- promoting layer disposed on at least one surface of the first electrode material, and a layer of pre-formed nanostructure-containing material comprising at least one of nanotubes and nanorods disposed on at least a portion of the adhesion-promoting layer.*

According to another aspect, a gas discharge device formed consistent with the principles of the present invention is set forth in amended claim 15. Amended claim 15 recites:

> *15. A gas discharge device comprising a sealed chamber containing at least one noble gas and a plurality of spaced electrodes, at least one electrode comprising a first electrode material, an adhesion-promoting layer disposed on at least one surface of the first electrode material, and a layer of pre-formed nanostructure-containing material comprising at least one of nanotubes and nanorods disposed on at least a portion of the adhesion-promoting layer.*

According to a further aspect, a lighting device constructed according to the principles of the present invention is defined by amended claim 39. Amended claim 39 recites:

> *39. A lighting device comprising a sealed chamber containing an excitable gas and at plurality of spaced electrodes, at least one of said electrodes comprising a first electrode material, an adhesion-promoting layer disposed on at least one surface of the first electrode material, and a layer of pre-formed nanostructure-containing material comprising at least one of nanotubes and nanorods disposed on at least a portion of the adhesion-promoting layer.*

According to yet another aspect, a method performed according to the principles of the present invention is set forth in amended claim 42. Amended claim 42 recites:

> *42. A method of providing a gas discharge device with smaller variances in mean breakdown voltage, increased breakdown reliability, smaller electron emission turn-on requirements, and stable electron emission at high current density, the gas discharge device comprising a sealed chamber containing at least one noble gas and a plurality of spaced electrodes, the method comprising:*
> *applying an adhesion-promoting layer to a surface of at least one of the plurality of electrodes; and*
> *applying a layer of pre-formed nanostructure-containing material comprising at least one of nanotubes and nanorods on to at least a portion of the adhesion-promoting layer.*

Gärtner et al. fails to anticipate amended claims 1, 15, 39 and 42.

Gärtner et al. discloses a low-temperature cathode having an emissive nanostructure. The construction described by *Gärtner* includes a holder (20), a metal layer (22), a substrate (24) and a coating (26) having an active surface layer (28). According to *Gärtner*, the active surface layer (28) consists of "ultrafine particles", or "nanostructures" (see, e.g.- column 6, lines 41-45). However, apart from describing these nanostructures as "ultrafine particles", *Gärtner et al.* is silent with regard to the form of these nanostructure materials. By contrast, claims 1, 15, 39 and 42 of the present invention require a

nanostructure containing material comprising at least one of nanotubes and nanorods. *Gärtner et al.* fails to disclose at least this aspect of the presently claimed invention. Therefore, *Gärtner et al.* fails to anticipate the presently claimed invention.

It is also noted that claim 14 stands rejected as being anticipated by *Gärtner et al.* However, claim 14 depends from claim 8. Thus, claim 14 includes, by definition, each and every limitation contained in claim 8. However, claim 8 has not been rejected on the basis of *Gärtner et al.* Thus, the rejection of claim 14 is clearly inappropriate, absent an explanation as to how the teachings of *Gärtner et al.* also satisfy the requirements of claim 8.

Claims 1, 5-8, 10-11, 22 and 43 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 6,448,701 to Hsu (hereafter "*Hsu*") on the grounds set forth on pages 4-5 of the Official Action.

Initially, it is noted that the rejection is improper in that it is incorrectly based on 35 U.S.C. § 102(b). *Hsu* does not qualify as prior art against the present invention under 35 U.S.C. § 102(b). The present application was filed on March 27, 2001. By contrast, *Hsu* was published well after the filing date of the present invention (i.e.- September 10, 2002). Thus, *Hsu* clearly does not constitute prior art under 35 U.S.C. § 102(b) since it was not published more than one year before the U.S. filing date of the present application. Should the rejection be maintained, it is incumbent upon the Examiner to identify an appropriate provision of 35 U.S.C. § 102 under which the patent qualifies as prior art against the presently claimed invention.

Hsu describes a self-aligned integrally formed nanofilament field emitter array. In this regard, the device of *Hsu* includes a substrate layer (102), a catalyst layer (104), an insulator (106), a gate layer (108), and a plurality of nanofilaments (114) which are grown *in situ* upon the catalyst layer (104).

By contrast, amended claims 1, 15, 39 and 42 each require a pre-formed nanostructure-containing material. In this regard, the present invention differs significantly from that of *Hsu*. For example, as described in paragraphs **[0038]** et al., the nanostructure containing material of the present invention is formed prior to its application to the electrode by techniques such as laser ablation, etc. Thus, the nanostructure-containing material of the present invention is fundamentally different from that of *Hsu*. Reconsideration and withdrawal of the rejection is respectfully requested.

Finally, it is also noted that claim 43 stands rejected as being anticipated by *Hsu*. However, claim 43 depends from claim 42. Claim 42 has not been rejected as being anticipated by *Hsu*. Thus, the rejection of claim 43, without explaining how the teachings of *Hsu* also satisfy the claim elements recited in claim 42 is clearly inappropriate.

CLAIM REJECTIONS UNDER 35 U.S.C. § 103

Claims 3-4, 9, 12-13, 16-17, 21, 23-24, 40, 45 and 50-51 stand rejected under 35 U.S.C. § 103(a) as being obvious over *Gärtner et al.* on the grounds set forth on pages 5-6 of the Official Action.

In the grounds for rejection, it is alleged that molybdenum is a well-known conductive material, the recited thickness of the adhesion promoting layer single-walled

carbon nanotubes and the range of thicknesses recited in claims 12-13 and 23-24, would all have been obvious to one of ordinary skill in the art in view of *Gärtner*. These assertions are respectfully traversed.

Apart from the lack of support in the teachings in *Gärtner et al.* for the above-mentioned assertions, as explained above, *Gärtner et al.* fails to disclose, or even suggest, an electrode comprising a nanostructure-containing material comprising at least one of nanotubes and nanorods as required by the amended claims. Thus, *Gärtner et al.* fails to render the above-mentioned claims obvious for at least the same reasons noted above. Reconsideration and withdrawal of the rejection is respectfully requested.

Claims 27-31 stand rejected under 35 U.S.C. § 103(a) as being obvious over U.S. Patent No. 4,707,762 to Yapoujian (hereafter "*Yapoujian*") in view of *Gärtner et al.*, on the grounds set forth on page 7 of the Official Action.

Yapoujian is cited as allegedly teaching the choice of argon as the inert gas and obtaining an optimum range of pressure as required by the presently claimed invention. However, even if the proposed combination of references were appropriate, the claimed invention would not result. Namely, *Yapoujian* fails to cure the above-noted deficiencies in connection with the teachings of *Gärtner et al.* Reconsideration and withdrawal of the rejection is respectfully requested.

Claims 32-33 and 35 stand rejected under 35 U.S.C. § 103(a) as being obvious over U.S. Patent No. 5,557,250 to Debbaut et al. (hereafter "*Debbaut et al.*") in view of *Gärtner et al.* on the grounds set forth on page 8 of the Official Action.

It is alleged that *Debbaut et al.* teaches a telecommunications network comprising a gas discharge tube as required by the presently claimed invention. However, even if the proposed combination were appropriate, the teachings of *Debbaut et al.* fail to cure the deficiencies of *Gärtner et al.*, as explained above. Reconsideration and withdrawal of the rejection is respectfully requested.

Claims 34 and 36 stand rejected under 35 U.S.C. § 103(a) as being obvious over *Debbaut et al.* in view of *Gärtner et al.*, and further in view of U.S. Patent No. 5,557,672 to Perry et al. (hereafter "*Perry et al.*") on the grounds set forth on page 8 of the Official Action.

It is alleged on page 8 that *Perry et al.* discloses a telecommunications network with essential switching gear as required by the presently claimed invention. However, even if the proposed combination were appropriate, the claimed invention would not result. Namely, the addition of the teachings of *Perry et al.* fail to cure the deficiencies noted in connection with the teachings of *Gärtner et al.*, and *Debbaut et al.*, for the reasons explained above. Reconsideration and withdrawal of the rejection is respectfully requested.

Claims 37 and 38 stand rejected under 35 U.S.C. § 103(a) as being obvious over *Debbaut et al.* in view of *Gärtner et al.*, and further in view of U.S. Patent No. 5,841,836 to Dunn et al. (hereafter "*Dunn et al.*") on the grounds set forth on page 9 of the Official Action.

Dunn et al. is cited as allegedly disclosing a telecommunications network with ASDL and HDSL lines in order to transfer data to customers. However, even if the proposed combination of references were appropriate, the claimed invention would not

result. Namely, the teachings of *Dunn et al.* fail to cure the previously noted deficiencies explained above in connection with the teachings of *Gärtner et al.* and *Debbaut et al.* Reconsideration and withdrawal of the rejection is respectfully requested.

Claim 44 stands rejected under 35 U.S.C. § 103(a) as being obvious over *Hsu* on the grounds set forth on page 9 of the Official Action.

It is alleged on page 9 that *Hsu* discloses a step of annealing the coated cathode but admits that *Hsu* fails to describe the pressure and temperature conditions of the annealing process. Nonetheless, it is asserted that claim 44 would have been rendered obvious by the teachings of *Hsu*.

However, as explained above, *Hsu* fails to disclose, or even suggest, a pre-formed nanostructure-containing material as required by the presently claimed invention. Thus, the grounds for rejection are deficient for at least this reason. Reconsideration and withdrawal of the rejection is respectfully requested.

CONCLUSION

From the foregoing, further and favorable action in the form of a Notice of Allowance is earnestly solicited. Should the Examiner feel that any issues remain, it is requested that the undersigned be contacted so that any such issues may be adequately addressed and prosecution of the instant application expedited.

Respectfully submitted,

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Attachment to Amendment dated January 9, 2003

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Page 2, Paragraph **[0005]**

U.S. Patent No. 6,280,697 [_____ (Serial No. 09/259,307] entitled "Nanotube-Based High Energy Material and Method"[)], the disclosure of which is incorporated herein by reference, in its entirety, discloses the fabrication of carbon-based nanotube materials and their use as a battery electrode material.

Page 2, Paragraph **[0006]**

U.S. Patent No. 6,277,318 [_____ (Serial No. 09/376,457] entitled "Method for Fabrication of Patterned Carbon Nanotube Films"[)], the disclosure of which is incorporated herein by reference, in its entirety, discloses a method of fabricating adherent, patterned carbon nanotube films onto a substrate.

Page 2, Paragraph **[0007]**

U.S. Patent No. 6,334,939 [_____ (Serial No. 09/594,844] entitled "Nanostructure-Based High Energy Material and Method"[)], the disclosure of which is incorporated herein by reference, in its entirety, discloses a nanostructure material having an intercalated alkali metal. Such materials are described as being useful in certain battery applications.

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Page 5, Paragraph **[0023]**

According to a further aspect, the present invention is directed to an improved circuit, optionally comprising at least one of an interface device box and central office switching gear, and comprising a gas discharge device of the present invention.

Page 7, Paragraph **[0036]**

According to the present invention, an electrode is formed, at least in part, by a nanostructure-containing material. Nanostructure-containing materials are characterized by having basic building blocks that are nanometer-sized in at least one direction. Examples of such basic building blocks include nanoparticles, cage-like fullerene molecules, carbon nanotubes, [carbon nanotubes,] and silicon nanorods. These basic building blocks can be formed, for example, of carbon, silicon, germanium, aluminum, silicon oxide, germanium oxide, silicon carbide, boron, boron nitride, and boron carbide, etc., or a mixture of such materials.

Page 7, Paragraph **[0037]**

According to a preferred embodiment of the present invention, the basic building block of the nanostructure-containing material is carbon nanotubes, preferably single-walled carbon nanotubes. These single-walled carbon nanotubes can be formed by what are now considered "conventional" techniques, such as laser ablation, arc-discharge, and chemical vapor deposition techniques. More specific details of such materials and their

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fabrication can be gleaned, for example, from U.S. Patent No. 6,334,939 [_____ (Serial No. 09/594,844)] and U.S. Patent No. _____ (Serial No. 09/259,307).

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Marked-up Claims 1, 4, 15, 39 and 42

1. (Amended) An electrode comprising a first electrode material, an adhesion-promoting layer disposed on at least one surface of the first electrode material, and a layer of pre-formed nanostructure-containing material comprising at least one of nanotubes and nanorods disposed on at least a portion of the adhesion-promoting layer.

4. (Amended) The electrode of claim [4] 1, wherein the adhesion promoting interlayer has a thickness of approximately 10-1,000 nm.

15. (Amended) A gas discharge device comprising a sealed chamber containing at least one noble gas and a plurality of spaced electrodes, at least one electrode comprising a first electrode material, an adhesion-promoting layer disposed on at least one surface of the first electrode material, and a layer of pre-formed nanostructure-containing material comprising at least one of nanotubes and nanorods disposed on at least a portion of the adhesion-promoting layer.

39. (Amended) A lighting device comprising a sealed chamber containing an excitable gas and at plurality of spaced electrodes, at least one of said electrodes comprising a first electrode material, an adhesion-promoting layer disposed on at least one surface of the first electrode material, and a layer of pre-formed nanostructure-containing material

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Marked-up Claims 1, 4, 15, 39 and 42

comprising at least one of nanotubes and nanorods disposed on at least a portion of the adhesion-promoting layer.

42. (Amended) A method of providing a gas discharge device with smaller variances in mean breakdown voltage, increased breakdown reliability, smaller electron emission turn-on requirements, and stable electron emission at high current density, the gas discharge device comprising a sealed chamber containing at least one noble gas and a plurality of spaced electrodes, the method comprising:

applying an adhesion-promoting layer to a surface of at least one of the plurality of electrodes; and

applying a layer of pre-formed nanostructure-containing material comprising at least one of nanotubes and nanorods on to at least a portion of the adhesion-promoting layer.